On Pet solenoid, RFQ and MEBT

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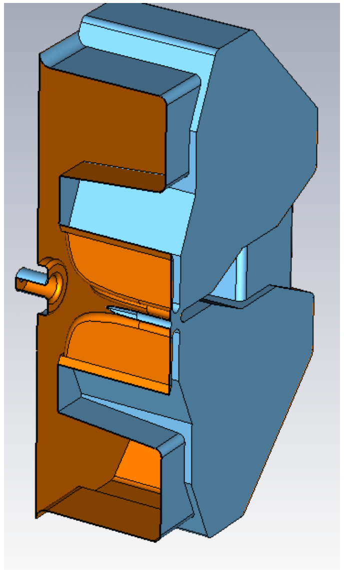
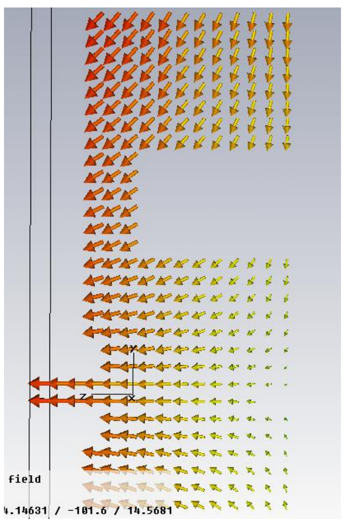
Outline

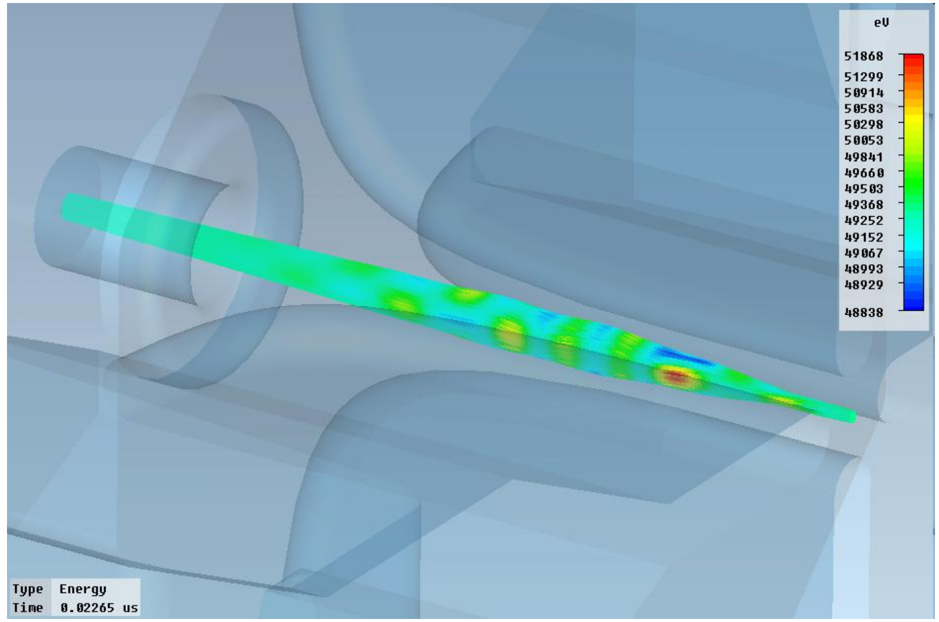
- Influence of solenoidal magnetic field on beam matching at RFQ input
- Bad behavior of RFQ resonant frequency during high power tests. Some possible reason.
- MEBT based on available quadrupole lenses.

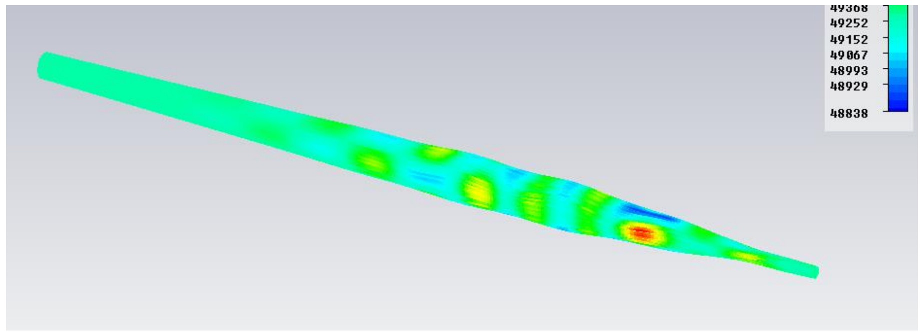
Beam in the matcher





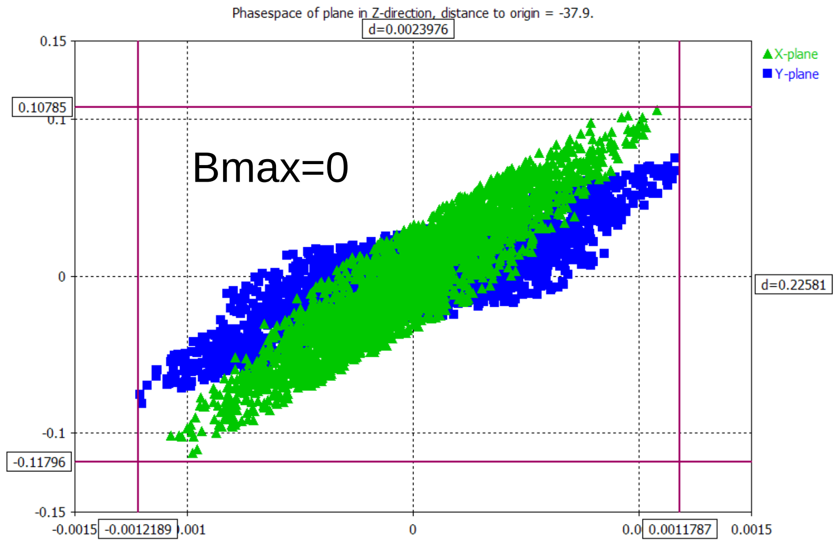
Input matcher and fringe solenoidal field

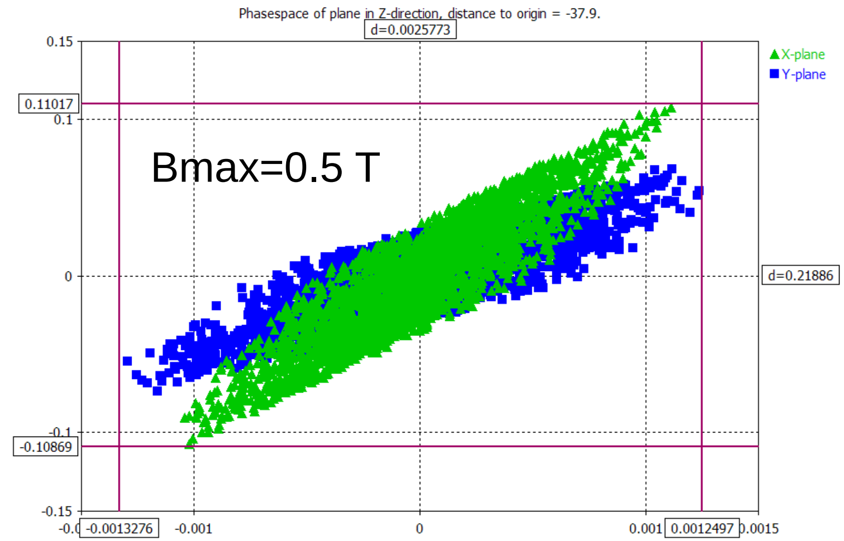




Beam matching without magnetic field.
Increasing quadrupole focusing can be seen.

Beam in the XX’ and YY’ phase space at some Z

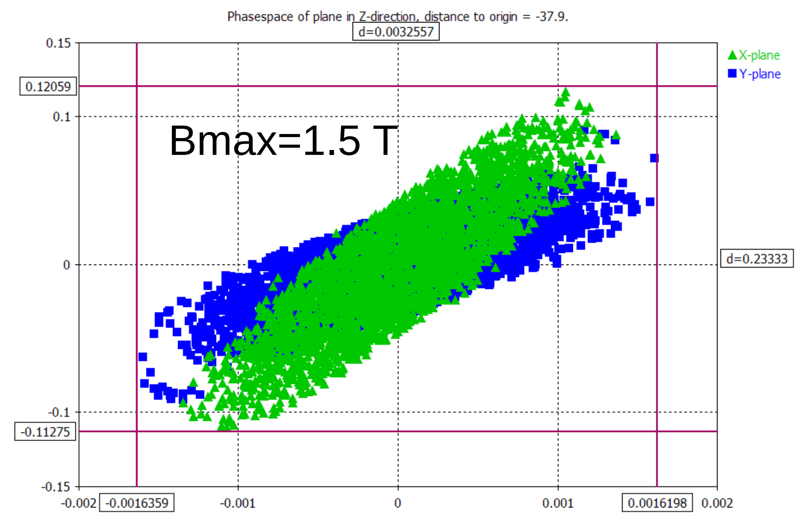




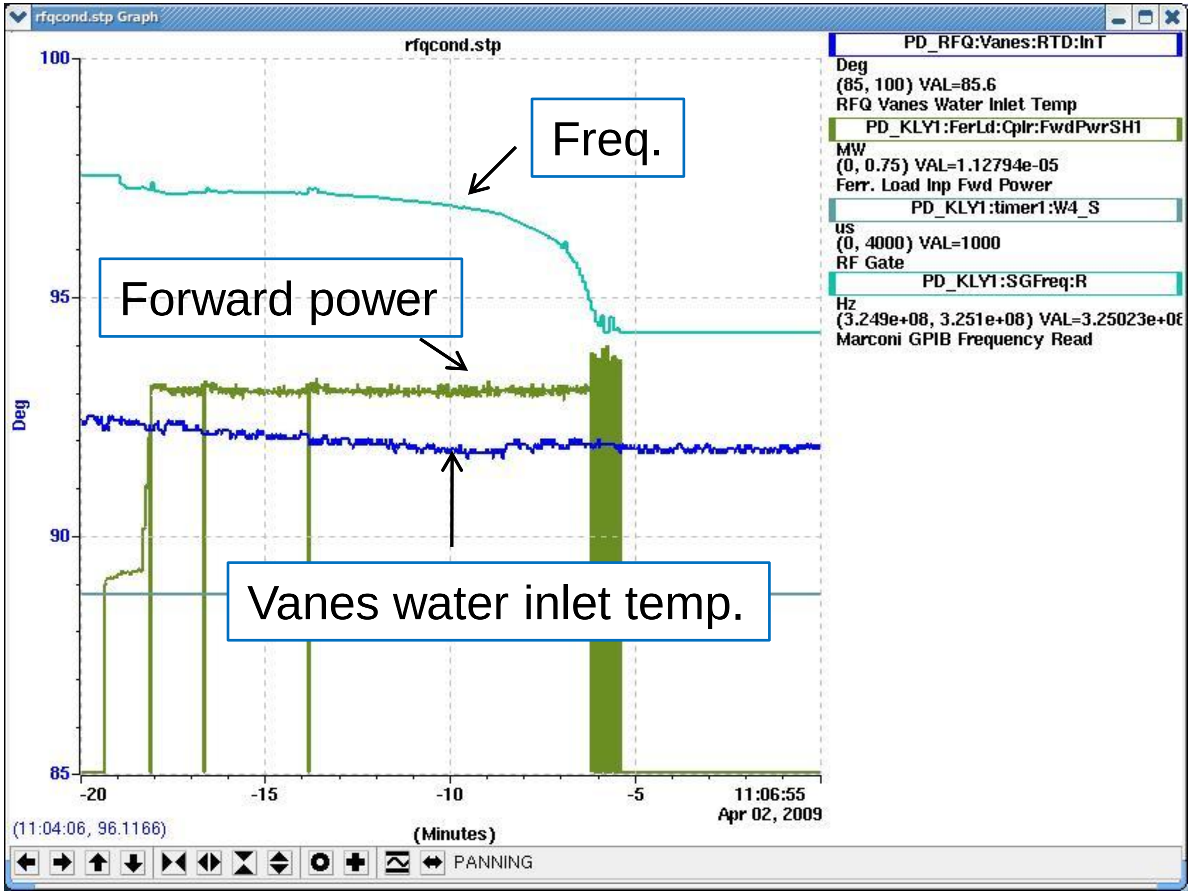
We don’t see impact of magnetic field because:

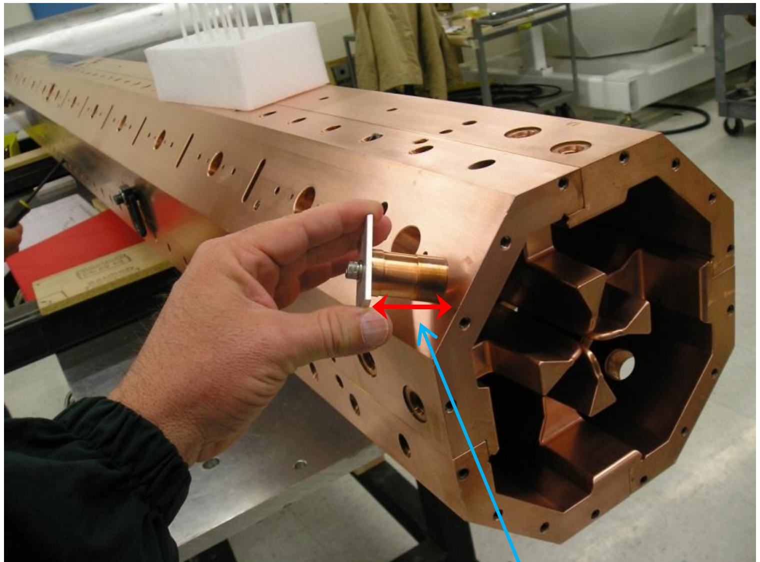
Magnetic force/Electric force = v*B/E

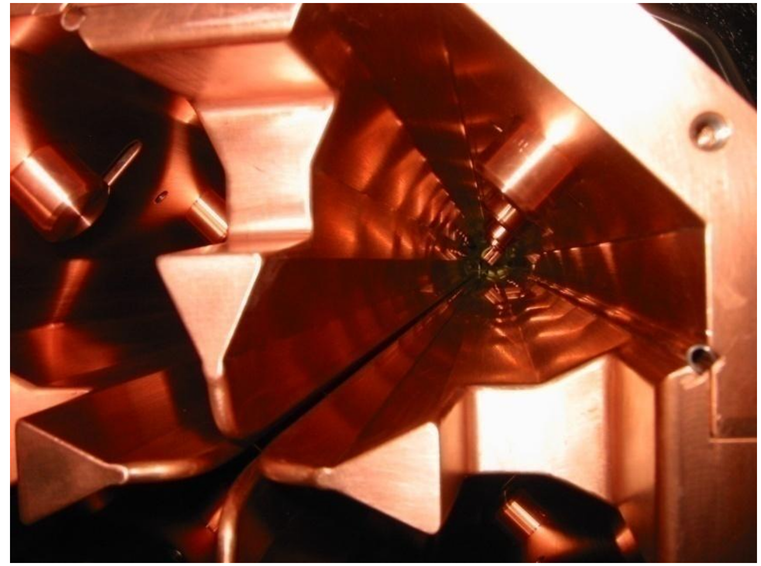
For beta=0.01, E=90kV/4mm and Bmax = 0.5 T this ratio is 0.07.



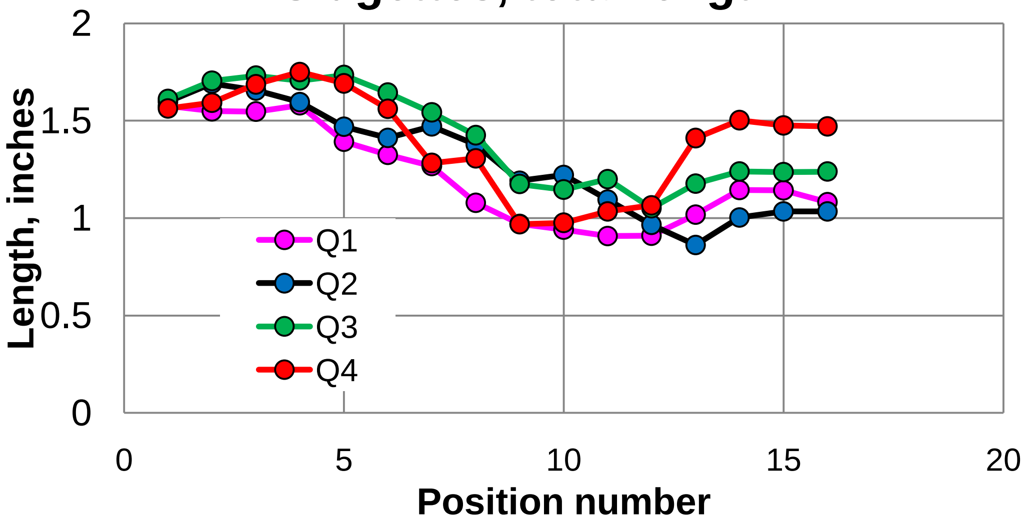
RFQ problem: everything - inlet and outlet water temperature, forward and reflected power, pick up signals – seem to be stable and almost constant during high power tests. But RFQ resonant frequency exponentially goes down.

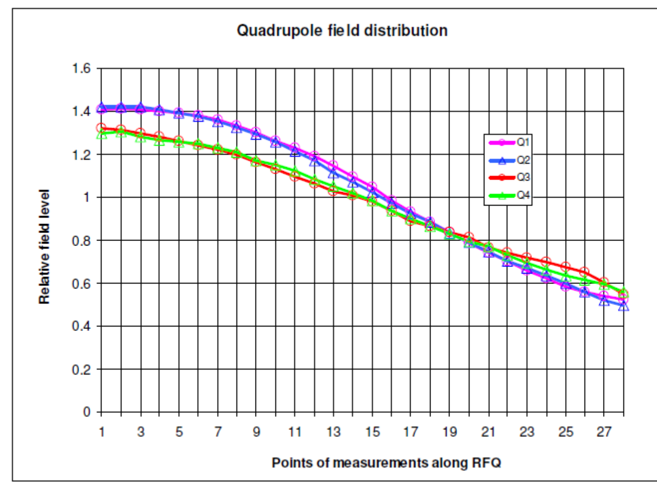






Slugettes, total length





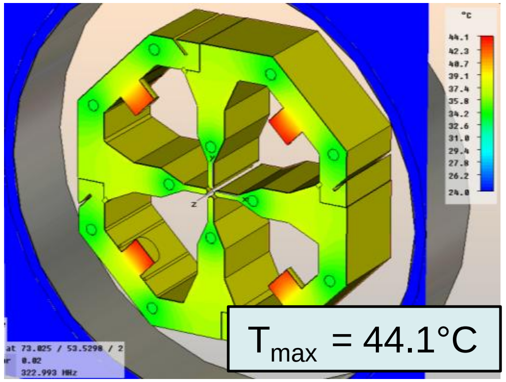
Field distribution along RFQ at presence of local frequency variation

Steady state temperature distributions for different length of slugettes

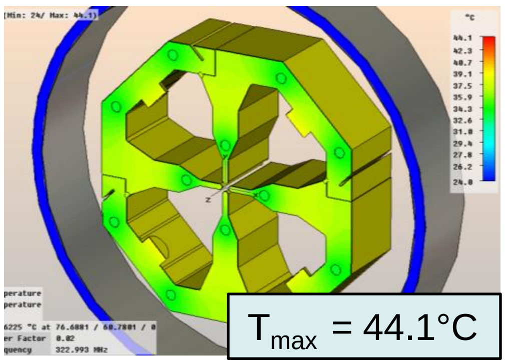
Length of the model is equal to “tuning” period (≈ 140 mm). RF losses approximately correspond to nominal. Body and vanes water temperatures are both equal to 33.8°C. Average temperature leads to the lower overall frequency. Longer slugettes are heated more and have more thermal expansions, that increase frequency . They cannot reverse the process, but can make local frequency pretty much different along RFQ. In the parts with **lower** local frequency the field level is **higher** (especially important is the case when the RFQ ends have different temperature) . The field and losses go to the parts with lower frequency, heating them and making frequency lower. In other words the same power is dissipated in smaller and smaller volume of RFQ.

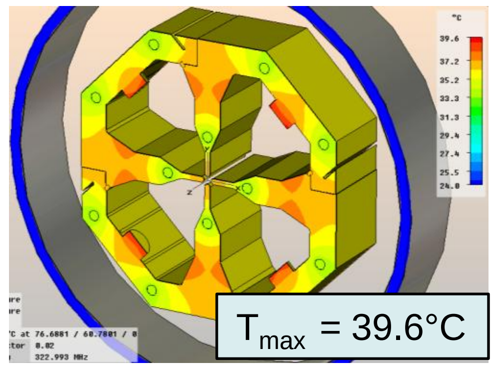
df=51*e-6*40mm=0.33kHz/°C (for each four in a plane)

20 mm

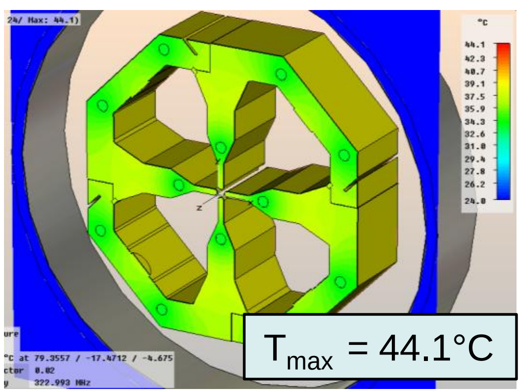


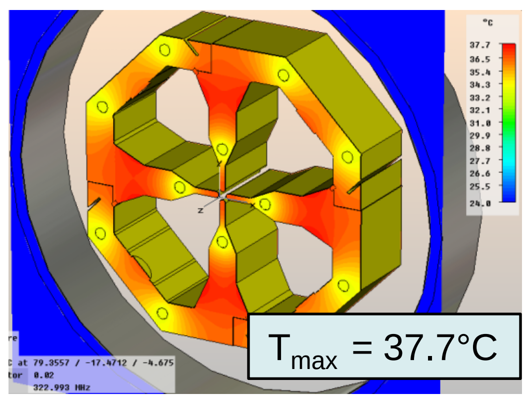
10 mm





1 mm





Six cavities beam test

Parts

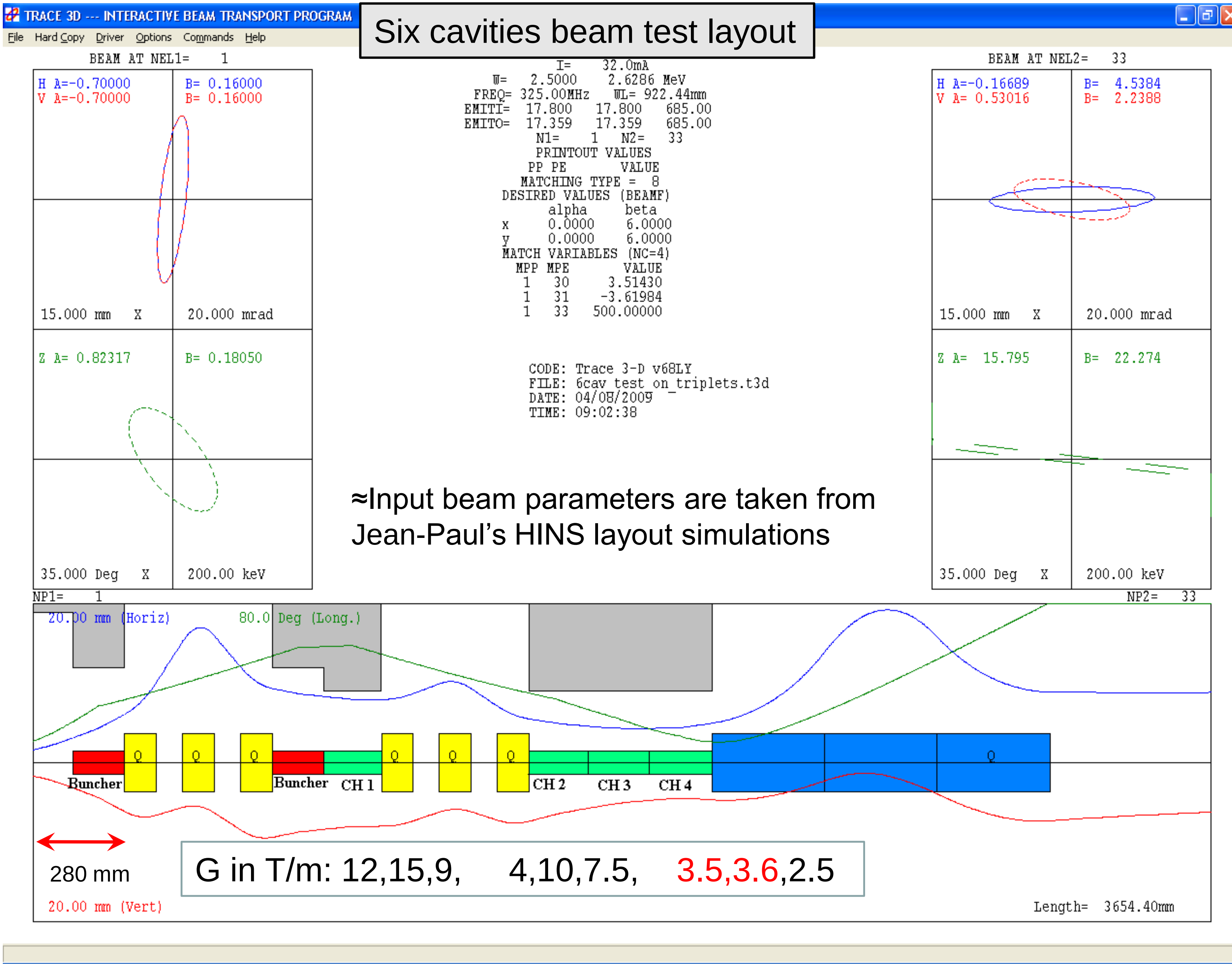
6 HE linac quads: Leff=10 cm, physical L=8.9 cm, bore 4.12 cm, tested up to 17 T/m

4 MI trim quads: Leff=35 cm, physical L=?, bore 11 cm, tested up to 2.9 T/m

2 Bunchers: flange to flange 16 cm

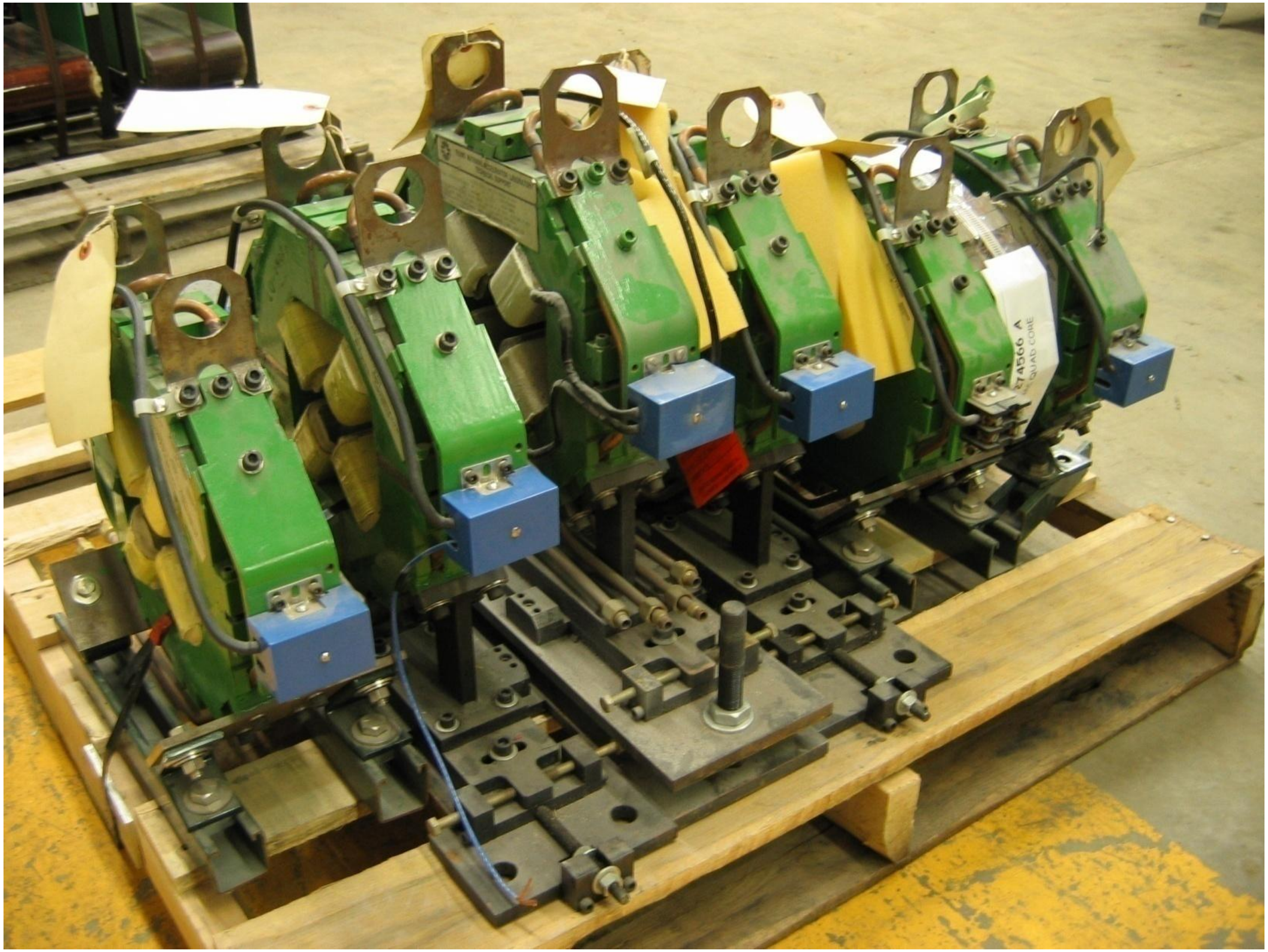
4 CH cavities: flange to flange 17.72, 18.22, 18.84 and 19.52 cm

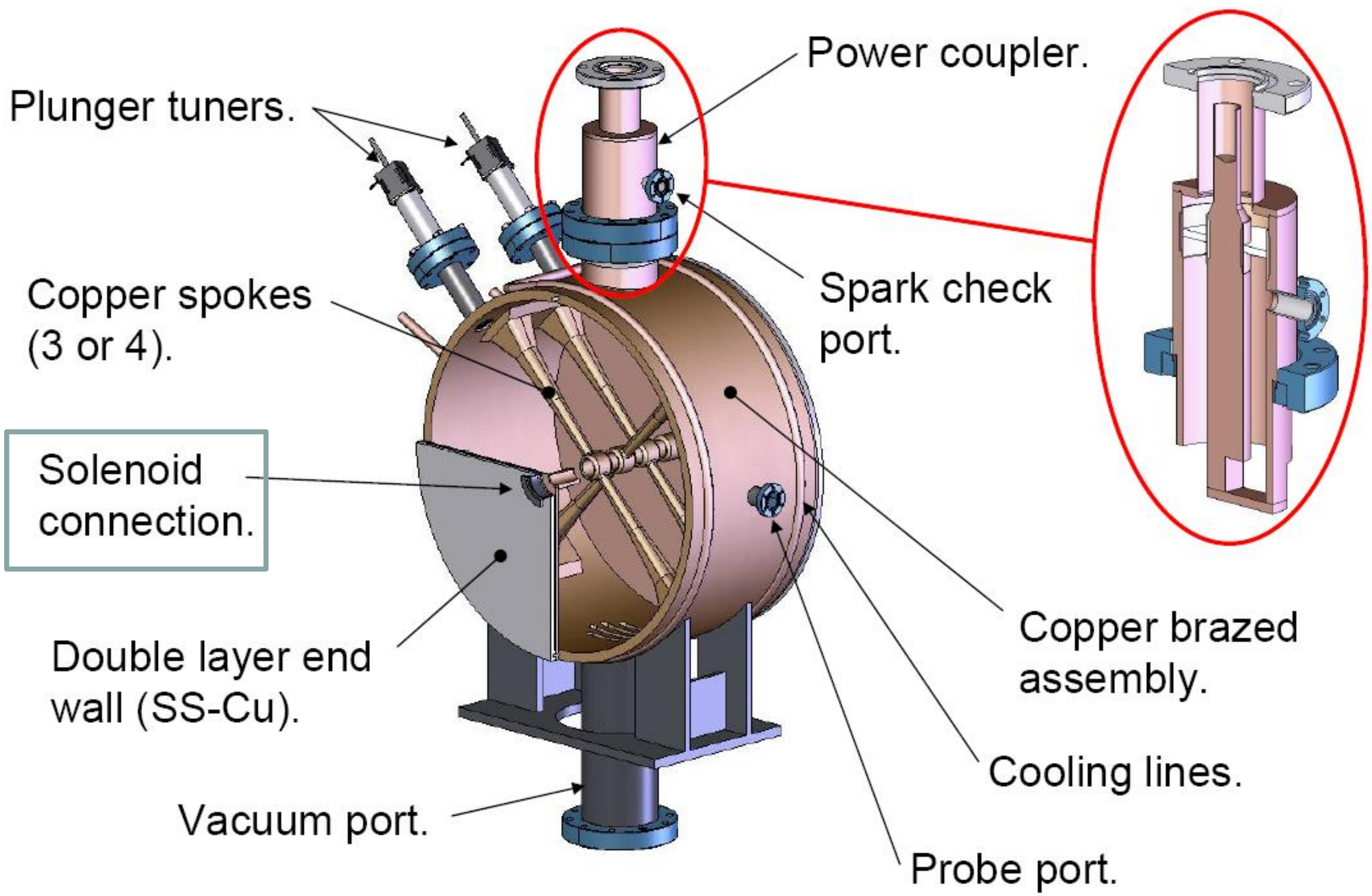
Six cavities beam test layout

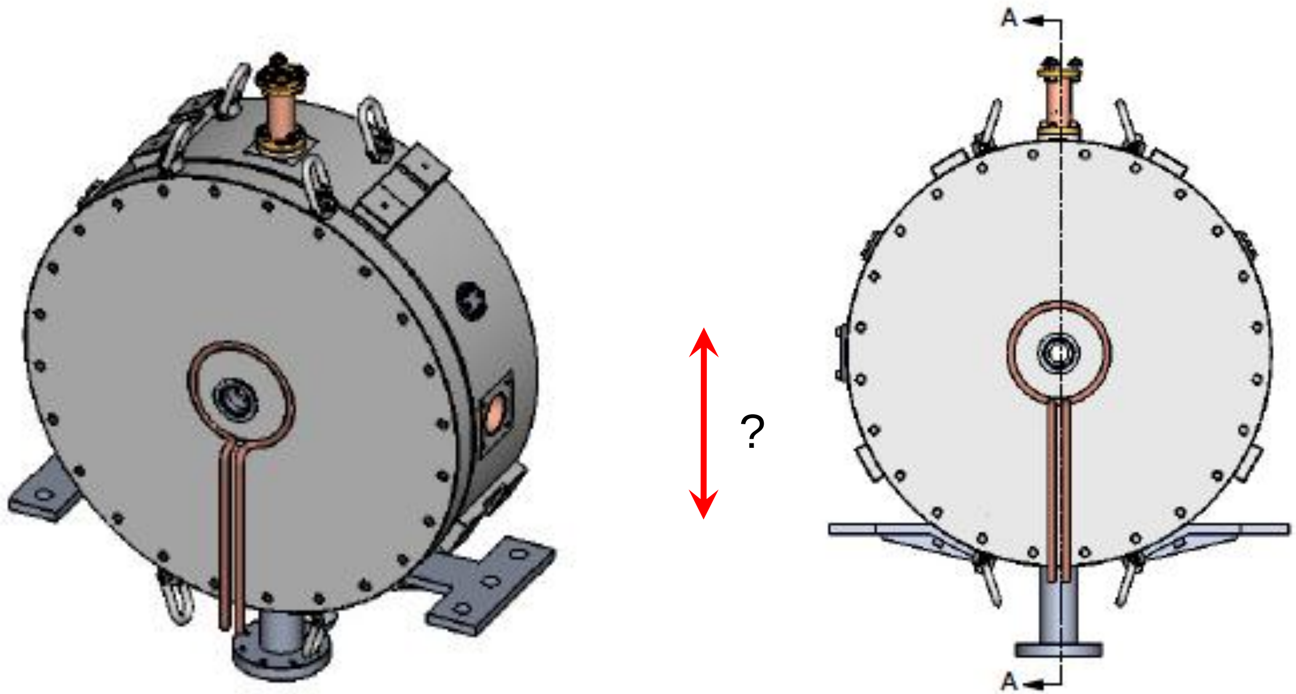


≈Input beam parameters are taken from Jean-Paul's HINS layout simulations

G in T/m: 12,15,9, 4,10,7.5, 3.5,3.6,2.5


274566 A
QUAD CORE


Power coupler.
Plunger tuners.
Copper spokes (3 or 4).
Spark check port.
Solenoid connection.
Copper brazed assembly.
Double layer end wall (SS-Cu).
Cooling lines.
Vacuum port.
Probe port.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1. TRACK simulations to determine beam losses.
2. Discuss the necessity of shielding with Mokhov
3. Design and manufacture beam pipes, supports, adjusting mechanisms etc.
4. Test all quadrupoles.
5. Measure beam just after RFQ.
6. Install first triplet. Measure beam after first triplet. Correct layout and quad settings if needed.